PATENT ABSTRACTS OF JAPAN

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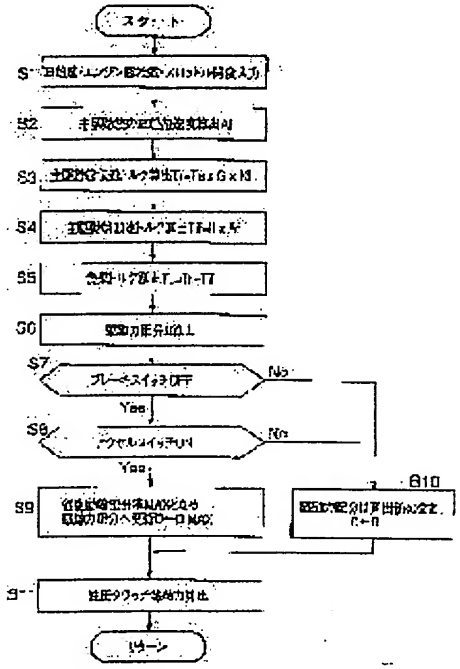
(54) DRIVING FORCE CONTROL APPARATUS FOR 4-WHEEL-DRIVE VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a driving force control apparatus for a 4-wheel-drive vehicle for controlling distribution of driving force to front and rear wheels according to an amount of acceleration slip of a main driving wheel so as to continue a 4-wheel-drive state only when necessary.
SOLUTION: This apparatus is constructed in such a way that when a driver requires the driving force, driving force distribution is adjusted so that a driving force distribution ratio of a driven wheel is updated to be the maximum value, and when the driver does not require the driving force, the driving force distribution is adjusted according to an amount of actual acceleration slip of the main driving wheel.



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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The driving force control unit of the four-flower drive vehicles characterized by providing the following. On the other hand, an order ring comes out, and it is a certain main driving wheel. ******** which is another side of an order ring. A slip detection means to detect the amount of acceleration slips of the main driving wheel. In judging that the operator is demanding driving force with a driving force demand judgment means to judge whether the operator is demanding driving force, and the driving force demand judgment means A renewal means of ******** distribution maximum to compute the driving force distribution ratio of an order ring so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel detected with the slip detection means, In judging that the operator is not demanding driving force with a driving force demand judgment means A slip correspondence driving force distribution calculation means to compute the driving force distribution ratio of a ring before and after responding to the amount of acceleration slips of the actual main driving wheel, A driving force adjustment means to adjust the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after computing with the renewal means of ******** distribution maximum, or a slip correspondence driving force distribution calculation means.
[Claim 2] The above-mentioned renewal means of ******** distribution maximum is the driving force control unit of the four-flower drive vehicles indicated to the claim 1 characterized by carrying out renewal of maximum of the amount of acceleration slips of the main driving wheel.
[Claim 3] The driving force control unit of the four-flower drive vehicles characterized by providing the following. On the other hand, an order ring comes out, and it is a certain main driving wheel. ******** which is another side of an order ring. A slip detection means to detect the amount of acceleration slips of the main driving wheel. In judging that the operator is demanding driving force with a driving force demand judgment means to judge whether the operator is demanding driving force, and the driving force demand judgment means A renewal means of ******** distribution maximum to compute the driving force distribution ratio of an order ring so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel detected with the slip detection means, In judging that the operator is not demanding driving force with a driving force demand judgment means A ******** distribution reduction means to compute the driving force distribution ratio of an order ring so that it may become reduction or zero about the rate of driving force distribution of ********, A driving force adjustment means to adjust the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after computing with the renewal means of ******** distribution maximum, or a ******** distribution reduction means.
[Claim 4] It is the driving force control unit of the four-flower drive vehicles indicated to the claim 3 characterized by having a car-body-speed detection means to detect the degree of car body speed, and making the above-mentioned ******** distribution reduction means into the driving force

distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the fall of the degree of car body speed.
[Claim 5] It is the driving force control unit of the four-flower drive vehicles indicated to the claim 3 characterized by having a wheel speed detection means to detect the degree of wheel speed, and making the above-mentioned ******** distribution reduction means into the driving force distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the fall of the degree of wheel speed.
[Claim 6] The above-mentioned ******** distribution reduction means is the driving force control unit of the four-flower drive vehicles indicated to the claim 3 characterized by considering as the driving force distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the passage of time.
[Claim 7] It is the driving force control unit of the four-flower drive vehicles which were equipped with a wheel speed detection means to detect the degree of wheel speed, and were indicated to either to the claims 1-6 characterized by the above-mentioned slip detection means calculating the amount of acceleration slips from the speed difference of an order ring.
[Claim 8] It is the driving-force control unit of the four flower drive vehicles which were equipped with a main driving wheel torque calculation means compute the driving torque transmitted to the main driving wheel, and a road surface reaction-force marginal torque calculation means compute the road surface reaction-force marginal torque of the main driving wheel, and indicated to either to the claims 1-6 characterized by for the above-mentioned slip detection means to calculate the amount of acceleration slips from the difference of the driving torque and the road surface reaction-force marginal torque of the main driving wheel transmitted to the main driving wheel.
[Claim 9] It is the driving force control unit of the four-flower drive vehicles indicated to either of the claims 1-8 characterized by judging that the operator is demanding driving force when it had a brakes operation detection means to detect whether brakes operation is carried out, it judges that the operator is not demanding driving force when carrying out brakes operation of the above-mentioned driving force demand judgment means is detected, and having not carried out brakes operation is detected.
[Claim 10] It is the driving-force control unit of the four flower drive vehicles indicated judging that the operator is not demanding driving force when it had an accelerator operation detection means to have detected whether accelerator operation is carried out, it judges that the operator is demanding driving force when it is detected that the above-mentioned driving force demand judgment means is carrying out accelerator operation, and having not carried out accelerator operation is detected to either of the claims 1-9 carry out as the feature.
[Claim 11] It has a car-body-speed detection means to detect the degree of car body speed, and a load correspondence driving force distribution calculation means to compute the driving force distribution ratio of an order ring according to load distribution of an order ring. When it is below the predetermined vehicle speed and calculation processing of a driving force distribution ratio is being performed with the renewal means of ******** distribution maximum By the driving force distribution ratio computed with the renewal means of ******** distribution maximum, and the driving force distribution ratio which a load correspondence driving force distribution calculation means computes The driving force control unit of the four-flower drive vehicles which chose the driving force distribution ratio with the larger driving force of ********, and were indicated to either of the claims 1-10 characterized by adjusting the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after choosing.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the driving force control unit of four-flower drive vehicles.
[0002]
[Description of the Prior Art] As a driving force control unit of the conventional four-flower drive vehicles, technology which is indicated by JP,7-172204,A is known, for example.
[0003] According to the above-mentioned official report, by the degree sensor of wheel speed, the driving force control unit of four-flower drive vehicles detects the degree of wheel speed of each wheel, asks for the degree difference of wheel speed of a front wheel and a rear wheel (henceforth front rear wheel ****), and its rate of change, and sets up driving force distribution of an order ring according to the degree difference of wheel speed, and its rate of change. Namely, only when the rear wheel which is the main driving wheel carries out an acceleration slip and front rear wheel **** arises, it will be in a four-flower drive state.
[0004]
[Problem(s) to be Solved by the Invention] However, such a driving force control unit of the conventional four-flower drive vehicles had the problem that it was not made to continue and run a four-flower drive state, when running the low mu road surface and bad road on which it is easy to slide and securing run stability and running-the-whole-distance nature, since it will not be in a four-flower drive state if front rear wheel **** does not arise. Moreover, since the main driving wheel of the driving force control unit of the conventional four-flower drive vehicles is in a slip state in a four-flower drive state, if the main driving wheel does not have a margin in the grip force and vehicles stability is considered, it is not desirable. Furthermore, the driving force control unit of the conventional four-flower drive vehicles was considered when a two-flower drive state and a four-flower drive state were frequently repeated on a low mu road surface, and it also had a possibility of making an operator sensing sense of incongruity, in that case by change of the acceleration of vehicles, or speed by the mechanical loss and electric loss at the time of a four-flower drive state.
[0005] this invention was made paying attention to such a conventional trouble, and only when required, it aims at offering the driving force control unit of the four-flower drive vehicles which can continue and run a four-flower drive state.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned problem, the driving force control unit of the four-flower drive vehicles concerning a claim 1 A slip detection means for an order ring to come out on the other hand, and to detect the amount of acceleration slips of a certain main driving wheel, ******** which is another side of an order ring, and the main driving wheel, In judging that the operator is demanding driving force with a driving force demand judgment means to judge whether the operator is demanding driving force, and the driving force demand

judgment means A renewal means of ******** distribution maximum to compute the driving force distribution ratio of an order ring so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel detected with the slip detection means, In judging that the operator is not demanding driving force with a driving force demand judgment means A slip correspondence driving force distribution calculation means to compute the driving force distribution ratio of a ring before and after responding to the amount of acceleration slips of the actual main driving wheel, It was characterized by having a driving force adjustment means to adjust the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after computing with the renewal means of ******** distribution maximum, or a slip correspondence driving force distribution calculation means.

[0007] Moreover, in the driving force control unit of the four-flower drive vehicles which indicated the driving force control unit of the four-flower drive vehicles concerning a claim 2 to the claim 1, the renewal means of ******** distribution maximum was characterized by carrying out renewal of maximum of the amount of acceleration slips of the main driving wheel.

[0008] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 3 A slip detection means for an order ring to come out on the other hand, and to detect the amount of acceleration slips of a certain main driving wheel, ******** which is another side of an order ring, and the main driving wheel, In judging that the operator is demanding driving force with a driving force demand judgment means to judge whether the operator is demanding driving force, and the driving force demand judgment means A renewal means of ******** distribution maximum to compute the driving force distribution ratio of an order ring so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel detected with the slip detection means, In judging that the operator is not demanding driving force with a driving force demand judgment means A ******** distribution reduction means to compute the driving force distribution ratio of an order ring so that it may become reduction or zero about the rate of driving force distribution of ********, It was characterized by having a driving force adjustment means to adjust the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after computing with the renewal means of ******** distribution maximum, or a ******** distribution reduction means.

[0009] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 4 was equipped with a car-body-speed detection means to detect the degree of car body speed, in the driving force control unit of the four-flower drive vehicles indicated to the claim 3, and it was characterized by making a ******** distribution reduction means into the driving force distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the fall of the degree of car body speed.

[0010] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 5 was equipped with a wheel speed detection means to detect the degree of wheel speed, in the driving force control unit of the four-flower drive vehicles indicated to the claim 3, and it was characterized by making a ******** distribution reduction means into the driving force distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the fall of the degree of wheel speed.

[0011] Moreover, in the driving force control unit of the four-flower drive vehicles which indicated the driving force control unit of the four-flower drive vehicles concerning a claim 6 to the claim 3, the ******** distribution reduction means was characterized by considering as the driving force distribution ratio of a ring before and after reducing the rate of driving force distribution of ******** according to the passage of time.

[0012] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 7 was equipped with a wheel speed detection means to detect the degree of wheel speed, in the

driving force control unit of the four-flower drive vehicles indicated to either to claims 1-6, and the slip detection means was characterized by calculating the amount of acceleration slips from the speed difference of an order ring.
[0013] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 8 In the driving force control unit of the four-flower drive vehicles indicated to either to claims 1-6 A main driving wheel torque calculation means to compute the driving torque transmitted to the main driving wheel, It had a road surface reaction force marginal torque calculation means to compute the road surface reaction force marginal torque of the main driving wheel, and the above-mentioned slip detection means was characterized by calculating the amount of acceleration slips from the difference of the driving torque and the road surface reaction force marginal torque of the main driving wheel which are transmitted to the main driving wheel.
[0014] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 9 It has a brakes operation detection means to detect whether brakes operation is carried out in the driving force control unit of the four-flower drive vehicles indicated to either of the claims 1-8. a driving force demand judgment means When it judged that the operator is not demanding driving force when carrying out brakes operation is detected, and having not carried out brakes operation was detected, it was characterized by judging that the operator is demanding driving force.
[0015] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 10 It has an accelerator operation detection means to detect whether accelerator operation is carried out in the driving force control unit of the four-flower drive vehicles indicated to either of the claims 1-9. a driving force demand judgment means When it judged that the operator is demanding driving force when carrying out accelerator operation is detected, and having not carried out accelerator operation was detected, it was characterized by judging that the operator is not demanding driving force.
[0016] Moreover, the driving force control unit of the four-flower drive vehicles concerning a claim 11 In the driving force control unit of the four-flower drive vehicles indicated to either of the claims 1-10 It has a car-body-speed detection means to detect the degree of car body speed, and a load correspondence driving force distribution calculation means to compute the driving force distribution ratio of an order ring according to load distribution of an order ring. When it is below the predetermined vehicle speed and calculation processing of a driving force distribution ratio is being performed with the renewal means of ******** distribution maximum By the driving force distribution ratio computed with the renewal means of ******** distribution maximum, and the driving force distribution ratio which a load correspondence driving force distribution calculation means computes The driving force distribution ratio with the larger driving force of ******** was chosen, and it was characterized by adjusting the driving force of a front wheel and a rear wheel to adjustable so that it may become the driving force distribution ratio of a ring before and after choosing.
[0017]
[Effect of the Invention] In judging that the operator is demanding driving force according to invention concerning a claim 1 In judging that the driving force distribution ratio of an order ring is computed so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel, and the operator is not demanding driving force Since adjustable setting of the driving force of a front wheel and a rear wheel is carried out so that the driving force distribution ratio of a ring before and after responding to the amount of acceleration slips of the actual main driving wheel may be computed and it may become the driving force distribution ratio of a ring before and after computing Even if the acceleration slip generated in the main driving wheel converges, while judging that the operator is demanding driving force, in order to continue a four-flower drive state, the effect that the running-the-whole-distance nature in reservation and bad road of the stability of the vehicles in a low mu road surface is securable is acquired. Moreover, by continuing a four-flower drive state, a leeway is

given in the grip force of the main driving wheel, it becomes advantageous to vehicles stability, and repeating a two-flower drive state and a four-flower drive state frequently on a low mu road surface can prevent being avoided and making an operator sense the sense of incongruity by change of the acceleration of vehicles, or speed by things. Furthermore, in order to consider as the driving force distribution ratio of a ring when judging that the operator was not demanding driving force, before and after responding to the amount of acceleration slips of the actual main driving wheel, the effect of not continuing a four-flower drive state more than required is acquired.

[0018] Moreover, since renewal of maximum of the amount of acceleration slips of the main driving wheel is carried out according to invention concerning a claim 2 According to the amount of acceleration slips of the main driving wheel updated by maximum, the driving force distribution ratio of an order ring is computed. It becomes the same as computing the driving force distribution ratio of an order ring so that the rate of driving force distribution of ******** may be updated to maximum as a result, and the effect that the rate of driving force distribution of ******** can be certainly updated to maximum is acquired.

[0019] moreover, in judging that the operator is demanding driving force according to invention concerning a claim 3 In judging that the driving force distribution ratio of an order ring is computed so that the rate of driving force distribution of ******** may be updated to maximum based on the amount of acceleration slips of the main driving wheel, and the operator is not demanding driving force Compute the driving force distribution ratio of an order ring, and since adjustable setting of the driving force of a front wheel and a rear wheel is carried out so that it may become the driving force distribution ratio of a ring before and after computing, so that it may become reduction or zero about the rate of driving force distribution of ******** In order to continue a four-flower drive state until it judges that the demand of an operator's driving force was lost, even if the acceleration slip generated in the main driving wheel converges, the effect that the running-the-whole-distance nature in reservation and bad road of the stability of the vehicles in a low mu road surface is securable is acquired. Moreover, by continuing a four-flower drive state, a leeway is given in the grip force of the main driving wheel, it becomes advantageous to vehicles stability, and repeating a two-flower drive state and a four-flower drive state frequently on a low mu road surface can prevent being avoided and making an operator sense the sense of incongruity by change of the acceleration of vehicles, or speed by things. Furthermore, the effect of not continuing a four-flower drive state more than required is acquired by making the rate of driving force distribution of preventing applying the driving force of ******** by reducing the rate of driving force distribution of ******** more than required ****, or ******** into zero, i.e., a two-flower drive state, if it judges that the operator is not demanding driving force.

[0020] Moreover, since the rate of driving force distribution of ******** is reduced according to the fall of the degree of car body speed when judging that the operator is not demanding driving force according to invention concerning a claim 4, the effect that aggravation of the vehicles stability by rapid driving force change of the main driving wheel can be prevented by changing into a two-flower drive state gradually is acquired.

[0021] Moreover, since the rate of driving force distribution of ******** is reduced according to the fall of the degree of wheel speed when judging that the operator is not demanding driving force according to invention concerning a claim 5, the effect that aggravation of the vehicles stability by rapid driving force change of the main driving wheel can be prevented by changing into a two-flower drive state gradually is acquired.

[0022] Moreover, when judging that the operator is not demanding driving force according to invention concerning a claim 6, in order to reduce the rate of driving force distribution of ******** according to the passage of time, the effect that aggravation of the vehicles stability by rapid driving force change of the main driving wheel can be gradually prevented by the bird clapper in the two-flower drive state is acquired.

[0023] Moreover, according to invention concerning a claim 7, since the amount of acceleration slips

is calculated from the speed difference of an order ring, the effect that the amount of acceleration slips is calculated certainly is acquired.
[0024] Moreover, since the amount of acceleration slips is calculated from the difference of the driving torque and the road surface reaction force marginal torque of the main driving wheel which are transmitted to the main driving wheel according to invention concerning a claim 8, even if the speed difference of an order ring is very small ** zero, the effect that the amount of acceleration slips is calculated is acquired.
[0025] Moreover, since it judges that the operator is demanding driving force when it judges that the operator is not demanding driving force when carrying out brakes operation is detected according to invention concerning a claim 9, and having not carried out brakes operation is detected, the effect that it is detectable whether the operator is demanding driving force certainly is acquired. Moreover, since it judges that the operator is not demanding driving force when it judges that the operator is demanding driving force when carrying out accelerator operation is detected according to invention concerning a claim 10, and having not carried out accelerator operation is detected, the effect that it is detectable whether the operator is demanding driving force certainly is acquired.
[0026] moreover, when according to invention concerning a claim 11 it is below the predetermined vehicle speed and calculation processing of a driving force distribution ratio is being performed with the renewal means of ******** distribution maximum By the driving force distribution ratio computed with the renewal means of ******** distribution maximum, and the driving force distribution ratio which a load correspondence driving force distribution calculation means computes Choose a driving force distribution ratio with the larger driving force of ********, and since the driving force of a front wheel and a rear wheel is adjusted to adjustable so that it may become the driving force distribution ratio of a ring before and after choosing By the driving force distribution by the order load being chosen, and considering as a four-flower drive state from the beginning, even when the acceleration slip before start has not arisen, at the time of the start which especially an acceleration slip tends to generate After an acceleration slip is generated, it excels in the acceleration nature at the time of start, or the stability of vehicles, and the effect of not continuing a four-flower drive state more than required is acquired rather than it changes into a four-flower drive state.
[0027]
[Embodiments of the Invention] First, the gestalt of operation of the first of this invention is explained based on a drawing. Drawing 1 is drawing showing the whole gestalt composition of operation of this invention. Moreover, the gestalt of this operation explains the vehicles in which a four-flower drive is possible on the basis of the two-flower drive which usually drives a rear wheel.
[0028] Among drawing, the output of the engine 1 of four-flower drive vehicles performs driving force distribution of an order ring with the driving force proportioning-control actuator 3 through transmission 2, and transmits it to the front driveshaft 4 and the rear driveshaft 5. The driving force transmitted to the front driveshaft 4 is transmitted to forward right ring 10FR and forward left ring 10floor line through the front differential gear 6 and the last shaft 7. Similarly, the driving force transmitted to the rear driveshaft 5 is transmitted to right rear ring 10RR and left rear ring 10RL through the rear differential gear 8 and the back shaft 9.
[0029] vehicles -- each -- wheel 10FR, 10floor line, 10RR, and 10 -- RL is equipped with degree sensor of wheel speed 12FR, 12floor line, 12RR, and 12RL, and each detection value is outputted to the driving force proportioning-control controller 11 Moreover, the driving force proportioning-control actuator 3 minds the hydraulic clutch between transmission 2 and the front driveshaft 4. In addition, you may be an electromagnetic clutch instead of a hydraulic clutch.
[0030] Moreover, a driving force demand of an operator is detected, namely, the accelerator switch 13 for detecting the existence of accelerator operation and the brake switch 14 which detects the existence of brakes operation output each detection value to the driving force proportioning-control controller 11. In addition, the accelerator opening sensor for detecting the state of accelerator

opening instead of the accelerator switch 13 may be used, and the brake stroke sensor for detecting the amount of brake-pedal strokes instead of the brake switch 14 may be used.
[0031] Moreover, it has the engine speed sensor 15 which detects the rotational frequency of an engine 1, and an engine speed sensor 15 outputs the detected detection value to the driving force proportioning-control controller 11. Moreover, the throttle valve of the inlet-pipe way of an engine 1 is equipped with the throttle opening sensor 16 which detects the opening of a throttle valve, and the throttle opening sensor 16 outputs the detected detection value to the driving force proportioning-control controller 11.
[0032] Moreover, the driving force proportioning-control controller 11 inputs the detection value of each sensor, and computes the amount of acceleration slips of the main driving wheel. First, the detection value of degree sensor of wheel speed 12FR, 12floor line, 12RR, and 12RL, the detection value of an engine speed sensor 15, and the detection value of the throttle opening sensor 16 are inputted, the transfer torque of the main driving wheel and the acceleration torque of the main driving wheel are searched for, and the road surface reaction force torque which is the amount of acceleration slips is computed from them. And from the state where the driving force distribution ratio of an order ring is usually 100% of 0% [of front wheels] : rear wheels, for example, driving force distribution is computed according to road surface reaction force torque, an instruction value is outputted to the driving force proportioning-control actuator 3, and the driving force proportioning-control actuator 3 is controlling the conclusion force of a hydraulic clutch, and controls driving force distribution of an order ring.
[0033] Next, based on drawing 2 , control processing of the driving force proportioning-control controller 11 is explained. Drawing 2 is the flow chart view showing the outline of control processing of the form of operation of the first of this invention. This data processing is performed every predetermined-time 10msec.
[0034] First, at Step S1, the driving force proportioning-control controller 11 inputs each detection value of degree sensor of wheel speed 12FR, 12floor line, 12RR, and 12RL, the detection value of an engine speed sensor 15, and the detection value of the throttle opening sensor 16, and shifts to Step S2. At Step S2, it asks for the wheel acceleration of the main driving wheel based on each detection value of inputted degree sensor of wheel speed 12RR, and 12RL, the average of a right-and-left ring is computed as wheel acceleration Af of the main driving wheel, and it shifts to Step S3.
[0035] At Step S3, engine output-torque Te is calculated from the detection value of an engine speed sensor 15, and the detection value of the throttle opening sensor 16, the transfer torque Tr of the main driving wheel is computed by multiplying by engine output-torque Te, gear ratio G of a change gear including the amplification ratio of a torque converter, and the rate Kf of driving force distribution of the main driving wheel, and it shifts to step S4. In step S4, the acceleration torque Tif of the main driving wheel, i.e., road surface reaction force marginal torque, is computed by multiplying by the drive-system inertia (gear ratio ****) of the main driving wheel, and the wheel acceleration Af of the main driving wheel, and it shifts to Step S5. At Step S5, the surplus torque tangent line is computed by subtracting the acceleration torque Tif of a main driving wheel from the transfer torque Tr of the main driving wheel, and it shifts to Step S6. At Step 6, the driving force distribution D is computed according to the surplus torque tangent line, and it shifts to Step S7 so that the surplus torque tangent line is large, and the rate of driving force distribution of ******** may become large.
[0036] At Step S7, it judges whether the detection value of the brake switch 14 is inputted and brakes operation is carried out. When the brake switch 14 judges that OFF, i.e., brakes operation, is not carried out, it shifts to Step S8, and when the brake switch 14 judges that ON, i.e., brakes operation, is carried out, it shifts to Step S10. At Step S8, it judges whether the detection value of the accelerator switch 13 is inputted and accelerator operation is carried out. When it is judged that the accelerator switch 13 turns on namely, operates [accelerator] it, it shifts to Step S9, and when

it is judged that the accelerator switch 13 does not turn off namely, accelerator operate it, it shifts to Step S10. And at Step S9, when the driving force distribution computed at the time of this calculation period has the rate of driving force distribution of ******** larger than the driving force distribution computed at the time of the last calculation period, it updates to this value (maximum), when the last value is larger, the maximum update process made into the value which uses the last value (maximum) for this calculation period is performed, and it shifts to Step S11. Moreover, at Step S10, it sets up so that the value of the driving force distribution computed at the time of this calculation period may be used as it is, and it shifts to Step S11. The instruction value which controls the conclusion force of the hydraulic clutch of the driving force proportioning-control actuator 3 which is satisfied [with Step S11] of the value of the driving force distribution processed at Step S9 or Step S10 is computed, and it outputs to the driving force proportioning-control actuator 3, and results in a return.

[0037] In addition, processing of Step S6 is available also as processing which computes surplus reaction force from surplus torque and the radius of gyration of a wheel, and computes the driving force distribution D according to surplus reaction force, although the driving force distribution D is computed according to surplus torque.

[0038] Furthermore, it explains based on drawing 3 . Drawing 3 is the timing diagram view of the form of operation of the first of this invention. here -- drawing 3 a -- each aging of the degree Vf of wheel speed of a front wheel, and the degree Vr of wheel speed of a rear wheel -- this drawing b -- aging of the transfer torque of a rear wheel -- this drawing c -- aging of the rate of driving force distribution of a front wheel -- aging of an accelerator switch detection value is shown in this drawing e, and aging of the detection value of a brake switch is shown for aging of coefficient of friction of a tire and a road surface in this drawing f in this drawing d

[0039] First, the degree Vr of wheel speed of a rear wheel becomes [as opposed to / the degree Vf of wheel speed of a front wheel / as a rear wheel will generate an acceleration slip when road surface reaction force / of the rear wheel which the transfer torque of a rear wheel goes up as the point in time of T1 to an operator steps on an accelerator, vehicles depart and it is shown in the solid line of drawing 3 b, and is shown in a dashed line / marginal torque is exceeded, and shown in drawing 3 a] large. Moreover, for OFF, as for the brake switch on which the accelerator switch shown in drawing 3 e is shown in ON and drawing 3 f, processing is performed, as for driving force distribution so that the rate of distribution to a front wheel may be updated by maximum. Then, if the time of T2 is exceeded, although the difference of the rear wheel transfer torque and road surface reaction force marginal torque which are shown in drawing 3 b becomes small, as for the rate of driving force distribution of a front wheel, maximum continues being continued as a maximum update process shows to drawing 3 c between the accelerator switch ON and the brake switch OFF. Then, although an acceleration slip of a rear wheel converges and the difference of rear wheel transfer torque and road surface reaction force marginal torque is lost at the time of T3, because of the state of the accelerator switch ON and the brake switch OFF, driving force distribution is continued by a maximum update process being continued as it is, as shown in drawing 3 c, maximum continues being continued and the rate of driving force distribution of a front wheel can continue a four-flower drive state. Then, although vehicles shift to the lower state of road surface coefficient of friction at the time of T4 and the road surface reaction force marginal torque of a rear wheel falls, since the four-flower drive state is continued, the transfer torque of a rear wheel does not exceed road surface reaction force marginal torque, and a rear wheel does not generate an acceleration slip again.

[0040] Then, an operator stops accelerator operation at the time of T5, and it is with OFF and a bird clapper, and an accelerator switch judges that the driving force demand was lost, stops a maximum update process, and performs processing made into the value of the driving force distribution computed according to the difference of actual rear wheel transfer torque and road surface reaction force marginal torque. However, since the difference of rear wheel transfer torque and road surface

reaction force marginal torque has not arisen in fact in this case and the rate of driving force distribution of a front wheel serves as driving force distribution used as zero, it will be in a two-flower drive state as a result. Then, although it becomes the brake switch ON because an operator does brakes operation at the time of T6, since it has judged that the driving force demand was already lost by Accelerator OFF at the time of T5, the processing made into the value of the driving force distribution computed according to the difference of actual rear wheel transfer torque and road surface reaction force marginal torque is continued. in addition, when it is judged that there is no driving force demand By not carrying out a maximum update process, i.e., considering as the value of the driving force distribution for which it asks from the difference of actual rear wheel transfer torque and road surface reaction force marginal torque, For example, an acceleration slip of a rear wheel is large by superfluous accelerator-on operation. Since a four-flower drive state is continued according to the difference of actual rear wheel transfer torque and road surface reaction force marginal torque when not being completed by the difference of rear wheel transfer torque and road surface reaction force marginal torque by inertia yet after it is judged that there is no driving force demand, It does not change to a two-flower drive state rapidly, and excels in reservation of the stability of vehicles.

[0041] Next, the form of operation of the second of this invention is explained. Although whole composition is the same as that of drawing 1 of the form of the first operation, the composition for the amount of acceleration slips of the main driving wheel performed by the driving force proportioning-control controller 11 computing, the composition for processing so that renewal of maximum of the rate of driving force distribution of ******** may be carried out, the composition of processing in case there is no driving force demand of an operator, and the composition for computing driving force distribution, when it is below the predetermined vehicle speed differ.

[0042] The composition for the amount of acceleration slips of the main driving wheel computing inputs the detection value of degree sensor of wheel speed 12FR, 12floor line, 12RR, and 12RL, calculates each average of a right-and-left front wheel and a right-and-left rear wheel, and computes a ring rotational-speed difference (front rear wheel ****) before and after being the difference of the front-wheel average and the rear wheel average as an amount of acceleration slips. Moreover, the composition for processing so that renewal of maximum of the rate of driving force distribution of ******** may be carried out carries out renewal of maximum of the front rear wheel **** computed as an amount of acceleration slips, and computes driving force distribution according to the front rear wheel **** which carried out renewal of maximum. Moreover, when there is no driving force demand of an operator, the composition of processing in case there is no driving force demand of an operator computes driving force distribution so that the rate of driving force distribution of ******** may decrease according to the fall of the degree of car body speed. Moreover, in below the predetermined vehicle speed, the composition for computing driving force distribution in below the predetermined vehicle speed compares the value of the driving force distribution which does simultaneously and establishes another driving force distribution calculation means, then is computed with the value of the driving force distribution computed based on the amount of acceleration slips, and chooses the value of the driving force distribution with the larger rate of driving force distribution of ********. Moreover, the driving force proportioning-control controller 11 is computing the degree of car body speed based on the inputted degree of wheel speed.

[0043] Next, based on drawing 4 , control processing of the driving force proportioning-control controller 11 is explained. Drawing 4 is the flow chart view showing the outline of control processing of the form of operation of the second of this invention. This data processing is performed every same predetermined-time 10msec like data processing of drawing 2 .

[0044] First, at Step S21, the driving force proportioning-control controller 11 inputs each detection value of degree sensor of wheel speed 12FR, 12floor line, 12RR, and 12RL, asks for the degree Vcarn of car body speed based on the degree of wheel speed, and shifts to Step S22. At Step S22,

after calculating the average of a right-and-left front wheel, and the average of a right-and-left rear wheel based on each degree of wheel speed inputted at Step S21, the average of the front wheel which is ******** is subtracted from the average of the rear wheel which is the main driving wheel, rear wheel **** **Vn is computed a front, and it shifts to Step S23. At Step S23, it judges whether the detection value of the brake switch 14 is inputted and brakes operation is carried out. When the brake switch 14 judges that OFF, i.e., brakes operation, is not carried out, it shifts to Step S24, and when the brake switch 14 judges that ON, i.e., brakes operation, is carried out, it shifts to Step S26. At Step S24, it judges whether the detection value of the accelerator switch 13 is inputted and accelerator operation is carried out. When it is judged that the accelerator switch 13 turns on namely, operates [accelerator] it, it shifts to Step S25, and when it is judged that the accelerator switch 13 does not turn off namely, accelerator operate it, it shifts to Step S26. And before computing at Step S25 at the time of the last calculation period and computing rather than rear wheel **** **Vn-1 at the time of this calculation period, when rear wheel **** **Vn is large, it updates to this value (maximum). in order to carry out processing which makes the last value (maximum) the value used for this calculation period when the last value is larger, namely, to compute driving force distribution -- front -- it processes so that the value of rear wheel **** **Vn may be made into the value updated by maximum, and a flag is set to 1, and it shifts to Step S27 At Step S26, to value **Vn-1 [moreover,] of front rear wheel **** used for calculation of driving force distribution at the time of the last calculation period Carry out processing set to value **Vn of front rear wheel **** used for calculation of driving force distribution of the value which multiplied by the value which **(ed) the degree Vcarn of car body speed called for this calculation period by degree Vcarn-of car body speed 1 which was able to be calculated the last calculation period, and the predetermined coefficient 0.7. That is, processing which reduces the value of front rear wheel **** for computing driving force distribution according to the degree of car body speed is carried out, a flag is set to 0, and it shifts to Step S27. at Step S27, as shown in the view 8 of JP,1-94025,A, the amount of acceleration slips increases, for example, -- be alike and hang -- it was processed at Step S25 or Step S26 from the operation expression and the map used as the property that the rate of driving force distribution of ******** becomes large -- front -- according to the value of rear wheel **** **Vn, the driving force distribution D1 of an order ring is computed, and it shifts to Step S28

[0045] At Step S28, it judges whether it is 15 or less km/h of predetermined vehicle speed, and, in below the predetermined vehicle speed, shifts to Step S29, and the degree Vcarn of car body speed shifts to Step S30, when larger than the predetermined vehicle speed. At Step S29, the rate of change of acceleration and deceleration of the degree of car body speed, i.e., the degree, is computed, and it shifts to Step S31. At Step S31, the basic-load distribution ratio of a ring before and after being able to find from a vehicles item in advance is amended according to the degree of acceleration and deceleration of vehicles, and it shifts to Step S32. namely, -- since load distribution of a rear wheel increases at the time of acceleration and load distribution for a front wheel increases at Step S31 at the time of a slowdown -- the variation of load distribution -- an amendment -- things are performed At Step S32, for example, it computes the driving force distribution D2 according to load distribution, when the vehicles of 50% of 50% [of front wheels] : rear wheels carry out load movement by acceleration and have become 60% of 40% [of front wheels] : rear wheels, they use driving force distribution as 60% of 40% [of front wheels] : rear wheels, and a basic-load distribution ratio shifts to Step S33. Here, driving force distribution is computed by the calculation method that Step S27 and Step S32 are separate respectively. At Step S33, it judges whether a flag is 1, if a flag is 1, it will shift to Step S34, and if a flag is not 1, it will shift to Step S35. At Step S34, the driving force distribution D1 computed at Step S27 is compared with the driving force distribution D2 computed at Step S32, driving force distribution of the direction where the rate of driving force distribution of ******** becomes large is chosen, and it shifts to Step S36. Moreover, at Step S35, processing which makes driving force distribution the

value D1 computed at Step S27 is carried out, and it shifts to Step S36. The instruction value which controls the conclusion force of the hydraulic clutch of the driving force proportioning-control actuator 3 which is satisfied [with Step S36] of the driving force distribution processed at Step S34 or Step S35 is computed, and it outputs to the driving force proportioning-control actuator 3, and results in a return.

[0046] In addition, you may carry out processing which makes the value of front rear wheel **** zero (**Vn=0) compulsorily instead of processing of Step S26. Moreover, you may carry out processing which computes front rear wheel **** instead of processing of Step S26 so that the rate of driving force distribution of ******** may be reduced according to the fall of the degree of wheel speed like invention according to claim 5 (for example, **Vn=**Vn-1x(Vfn/Vfn -1) x predetermined coefficient 0.7). Moreover, you may carry out processing which subtracts a predetermined value from the value of front rear wheel **** used for the last calculation period like invention according to claim 6 instead of processing of Step S26 (for example, **Vn=**Vn-predetermined value 1 km/h).

[0047] Furthermore, it explains based on drawing 5 . Drawing 5 is the timing diagram view of the form of operation of the second of this invention. The conditions of illustration are the same as that of aforementioned drawing 3 except b. Aging of front rear wheel **** which subtracted the degree Vf of wheel speed of a front wheel from the degree Vr of wheel speed of a rear wheel is shown in drawing 5 b.

[0048] First, it is running in the state of a four-flower drive by the driving force distribution according to the load distribution which amended basic-load distribution of an order ring according to acceleration until an operator steps on an accelerator from the time of T11, vehicles depart and the vehicle speed reaches 15 km/h. Then, if the vehicle speed exceeds 15 km/h at the time of T12, although it will come to carry out processing considered as the driving force distribution according to front rear wheel ****, since front rear wheel **** has not arisen in fact as shown in drawing 5 a and b, it will be in a two-flower drive state. Then, if vehicles shift to the lower state of road surface coefficient of friction, the road surface reaction force limitation of a rear wheel falls and the driving force of a rear wheel exceeds the road surface reaction force limitation of a rear wheel at the time of T13, a rear wheel will generate an acceleration slip. Since the degree Vr of wheel speed of a rear wheel becomes large to the degree Vf of wheel speed of a front wheel at this time as shown in drawing 5 a, front rear wheel **** arises between the degree Vf of wheel speed of a front wheel, and the degree Vr of wheel speed of a rear wheel. Moreover, it is continued by updating the rate of driving force distribution of a front wheel maximum according to the value of front rear wheel **** by which renewal of maximum of the brake switch on which the accelerator switch shown in drawing 5 e is shown in ON and drawing 5 f was carried out as processing which updates front rear wheel **** to maximum was performed for OFF as shown in drawing 5 b, and shown in drawing 5 c because it is controlled by driving force distribution of an order ring. Then, for the state of the accelerator switch ON and the brake switch OFF, although front rear wheel **** of the practice shown in drawing 5 a by reduction of the driving force of a rear wheel decreases, an acceleration slip of a rear wheel converges at the time of T14 and front rear wheel **** of practice is lost, as the value of front rear wheel **** used for the operation of driving force by maximum update process is shown in drawing 5 b, maximum continues being continued. Consequently, since the rate of driving force distribution of a front wheel is continued after having been updated by maximum, as shown in drawing 5 c, the rate of driving force distribution of a front wheel does not serve as zero, but can continue a four-flower drive state.

[0049] Then, an operator stops accelerator operation at the time of T15, and an accelerator switch is with OFF and a bird clapper. In order to judge that the driving force demand was lost, and to perform processing which reduces the value according to the vehicle speed based on the value of front rear wheel **** of the last data processing instead of being a maximum update process of front rear wheel ****, the fall of the vehicle speed -- ** -- the value of front rear wheel **** used

for both data processing becomes small, and approaches a two-flower drive state gradually Then, although it becomes the brake switch ON because an operator does brakes operation at the time of T16, since it has judged that the driving force demand was already lost by Accelerator OFF at the time of T15, the processing which reduces the value according to the vehicle speed based on the value of front rear wheel **** of the last data processing is continued.

[0050] Then, although the vehicle speed becomes 15 or less km/h again Since processing computed by carrying out [processing] renewal of maximum is not performed in order to judge that there is no driving force demand from the state of an accelerator switch and a brake switch Processing which chooses the driving force distribution with the larger driving force of ******** by the driving force distribution ratio computed according to the driving force distribution and load distribution which are computed by renewal of maximum being carried out is not performed, either. Processing only by the calculation value of the driving force distribution according to front rear wheel **** is continued, and it will be in a two-flower drive state gradually according to the vehicle speed.

[0051] As explained above, in four-flower drive vehicles equipped with a driving force proportioning-control means, on the low mu road surface and bad road where an acceleration slip tends to occur frequently, the running-the-whole-distance nature in reservation and bad road of the stability of vehicles is securable, and only when required, a four-flower drive state can be continued by carrying out this invention. Moreover, by continuing a four-flower drive state, a leeway is given in the grip force of the main driving wheel, it becomes advantageous to vehicles stability, and repeating a two-flower drive state and a four-flower drive state frequently on a low mu road surface can prevent being avoided and making an operator sense the sense of incongruity by change of the acceleration of vehicles, or speed by things.

[0052] Moreover, Step S1 of data processing of drawing 2 - Step S5 and Step S21 of data processing of drawing 4 - Step S22 constitute the acceleration slip detection means of this invention. Moreover, Step S7 of data processing of drawing 2 - Step S8 and Step S23 of data processing of drawing 4 - Step S24 constitute the driving force demand judgment means of this invention. Moreover, Step S25 of step S9 of data processing of drawing 2 and data processing of drawing 4 constitutes the renewal means of ******** distribution maximum of this invention. Moreover, Step S10 of data processing of drawing 2 constitutes the slip correspondence driving force distribution calculation means of this invention. Moreover, Step S3 of data processing of drawing 2 constitutes the main driving wheel torque calculation means of this invention, and step S4 constitutes the road surface reaction force marginal torque calculation means of this invention. Moreover, Step S26 of data processing of drawing 4 constitutes the ******** distribution reduction means of this invention. Moreover, Step S29 of data processing of drawing 4 - Step S32 constitute the load correspondence driving force distribution calculation means of this invention. Moreover, the driving force proportioning-control actuator 3 of drawing 1 constitutes the driving force adjustment means of this invention.

[0053] In addition, although it is made to compute the driving force distribution ratio of an order ring with the gestalt of the above-mentioned implementation, it is the same even if it computes the driving force transmitted to a road surface from the driving torque transmitted to ******** instead of or ********. [calculation of a driving force distribution ratio]

[0054] In addition, with the gestalt of the above-mentioned implementation, although the load correspondence driving force distribution calculation means explained the case where an order load distribution ratio was made into a driving force distribution ratio, you may process it so that it may consider as fixed driving force distribution (50% of for example, 50% [of front wheels] : rear wheels) according to load distribution, before and after being also alike other than this.

[0055] In addition, although the gestalt of the above-mentioned implementation explained the case where accelerator operation and brakes operation were combined, as a driving force demand judgment means, either [one] accelerator operation or brakes operation are sufficient. Since it is detectable whether there is any demand of an operator's driving force to have combined them more

appropriately [direction] since it thinks when operating **, an accelerator, and a brake simultaneously, it is desirable.
[0056] In addition, although the gestalt of the above-mentioned implementation explained the vehicles in which a four-flower drive is possible on the basis of the two-flower drive which usually drives a rear wheel, it is applicable, even if it is other gestalten, if it is the vehicles which can control driving force distribution and in which a four-flower drive is possible. Moreover, it is applicable also to the vehicles which drive one side of an order ring with an internal combustion engine, for example, and drive another side of an order ring with a motor also except the vehicles which distribute the output of an internal combustion engine like the gestalt of the above-mentioned implementation forward and backward, and in which a four-flower drive is possible and in which a four-flower drive is possible, and the vehicles which are driven with an internal combustion engine or a motor with separate front wheel and rear wheel and in which a four-flower drive is possible
[0057] In addition, although not explained, driving force distribution is not further cared about with the form of the above-mentioned implementation as for a method of an amendment combining well-known technology (for example, well-known technology for preventing a tight braking phenomenon) etc. based on this invention.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the whole gestalt composition of operation of this invention.
[Drawing 2] It is the control flow chart view of the gestalt of operation of the first of this invention.
[Drawing 3] It is the timing diagram view of the gestalt of operation of the first of this invention.
[Drawing 4] It is the control flow chart view of the gestalt of operation of the second of this invention.
[Drawing 5] It is the timing diagram view of the gestalt of operation of the second of this invention.
[Description of Notations]
1: Engine
3: Driving force proportioning-control actuator
11: Driving force proportioning-control controller
12FR(s), 12floor line, 12RR, 12RL: The degree sensor of wheel speed
13: Accelerator switch
14: Brake switch

[Translation done.]

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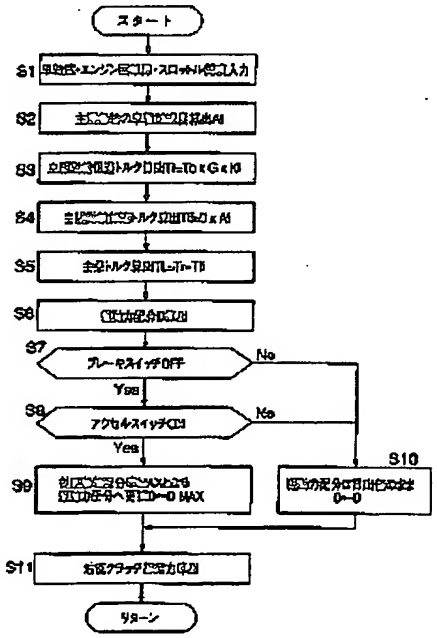
ＥＦ１４　ＥＦ１９　ＥＦ２４　ＥＦ２７

(54)【発明の名称】　４輪駆動車両の駆動力制御装置

(57)【要約】
【目的】　主駆動輪の加速スリップ量に応じて前後輪への駆動力配分を制御する４輪駆動車両の駆動力制御装置において、必要な時のみに４輪駆動状態を維持できる４輪駆動車両の駆動力制御装置を提供すること。
【構成】　運転者が駆動力の要求をしている場合は、従駆動輪の駆動力配分率が最大値更新される値に駆動力配分を調整し、運転者が駆動力の要求をしていない場合は、実際の主駆動輪の加速スリップ量に応じて駆動力配分を調整する構成とした。



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【特許請求の範囲】

【請求項１】　前後輪の一方である主駆動輪と．前後輪の他方である従駆動輪と．主駆動輪の加速スリップ量を検出するスリップ検出手段と、運転者が駆動力の要求をしているか否かを判断する駆動力要求判断手段と．駆動力要求判断手段で運転者が駆動力の要求をしていると判断する場合には．スリップ検出手段で検出した主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出する従駆動力配分最大値更新手段と、駆動力要求判断手段で運転者が駆動力の要求をしていないと判断する場合には．実際の主駆動輪の加速スリップ量に応じた前後輪の駆動力配分比を算出するスリップ対応駆動力配分算出手段と．従駆動力配分最大値更新手段またはスリップ対応駆動力配分算出手段で算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整する駆動力調整手段とを備えたことを特徴とする４輪駆動車両の駆動力制御装置。

【請求項２】　上記従駆動力配分最大値更新手段は、主駆動輪の加速スリップ量を最大値更新することを特徴とする請求項１に記載した４輪駆動車両の駆動力制御装置。

【請求項３】　前後輪の一方である主駆動輪と．前後輪の他方である従駆動輪と．主駆動輪の加速スリップ量を検出するスリップ検出手段と、運転者が駆動力の要求をしているか否かを判断する駆動力要求判断手段と．駆動力要求判断手段で運転者が駆動力の要求をしていると判断する場合には．スリップ検出手段で検出した主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出する従駆動力配分最大値更新手段と、駆動力要求判断手段で運転者が駆動力の要求をしていないと判断する場合には．従駆動輪の駆動力配分率を低減またはゼロとなるように前後輪の駆動力配分比を算出する従駆動力配分低減手段と、従駆動力配分最大値更新手段または従駆動力配分低減手段で算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整する駆動力調整手段とを備えたことを特徴とする４輪駆動車両の駆動力制御装置。

【請求項４】　車体速度を検出する車体速検出手段を備え．上記従駆動力配分低減手段は、車体速度の低下に応じて．従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とする請求項３に記載した４輪駆動車両の駆動力制御装置。

【請求項５】　車輪速度を検出する車輪速検出手段を備え．上記従駆動力配分低減手段は、車輪速度の低下に応じて．従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とする請求項３に記載した４輪駆動車両の駆動力制御装置。

【請求項６】　上記従駆動力配分低減手段は、時間の経過に応じて、従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とする請求項３に記載した４輪駆動車両の駆動力制御装置。

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【請求項７】　車輪速度を検出する車輪速検出手段を備え．上記スリップ検出手段は、前後輪の速度差から加速スリップ量を求めることを特徴とする請求項１から６までのいずれかに記載した４輪駆動車両の駆動力制御装置。

【請求項８】　主駆動輪に伝達される駆動トルクを算出する主駆動輪トルク算出手段と、主駆動輪の路面反力限界トルクを算出する路面反力限界トルク算出手段とを備え．上記スリップ検出手段は、主駆動輪に伝達される駆動トルクと主駆動輪の路面反力限界トルクとの差から加速スリップ量を求めることを特徴とする請求項１から６までのいずれかに記載した４輪駆動車両の駆動力制御装置。

【請求項９】　ブレーキ操作をしているか否かを検出するブレーキ操作検出手段を備え、上記駆動力要求判断手段は．ブレーキ操作していることを検出した場合には運転者が駆動力の要求をしていないと判断し、ブレーキ操作していないことを検出した場合には運転者が駆動力の要求をしていると判断することを特徴とする請求項１から８のいずれかに記載した４輪駆動車両の駆動力制御装置。

【請求項１０】　アクセル操作をしているか否かを検出するアクセル操作検出手段を備え、上記駆動力要求判断手段は、アクセル操作していることを検出した場合には運転者が駆動力の要求をしていると判断し、アクセル操作していないことを検出した場合には運転者が駆動力の要求をしていないと判断することを特徴とする請求項１から９のいずれかに記載した４輪駆動車両の駆動力制御装置。

【請求項１１】　車体速度を検出する車体速検出手段と．前後輪の荷重配分に応じて前後輪の駆動力配分比を算出する荷重対応駆動力配分算出手段とを備え．所定の車速以下でかつ従駆動力配分最大値更新手段で駆動力配分比の算出処理を行なっている場合には、従駆動力配分最大値更新手段で算出した駆動力配分比と、荷重対応駆動力配分算出手段が算出する駆動力配分比とで．従駆動輪の駆動力が大きい方の駆動力配分比を選択し．選択された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整することを特徴とする請求項１から１０のいずれかに記載した４輪駆動車両の駆動力制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は．４輪駆動車両の駆動力制御装置に関する。

【０００２】

【従来の技術】従来の４輪駆動車両の駆動力制御装置と

しては、例えば、特開平７－１７２２０４号公報に記載されているような技術が知られている。

【０００３】上記公報によれば、４輪駆動車両の駆動力制御装置は、車輪速度センサによって各車輪の車輪速度を検出し、前輪と後輪との車輪速度差（以下、前後輪速差ともいう）、およびその変化率を求め、車輪速度差およびその変化率に応じて前後輪の駆動力配分を設定するようになっていた。すなわち、主駆動輪である後輪が加速スリップし、前後輪速差が生じる時にのみ、４輪駆動状態になるようになっていた。

【０００４】

【発明が解決しようとする課題】しかしながら、このような従来の４輪駆動車両の駆動力制御装置は、前後輪速差が生じなければ４輪駆動状態にならないため、滑りやすい低μ路面や悪路を走行する場合は、走行安定性や走破性を確保する上で４輪駆動状態を継続して走行したい時に、それができないという問題があった。また、従来の４輪駆動車両の駆動力制御装置は、４輪駆動状態の時には主駆動輪はスリップ状態であるため、主駆動輪はグリップ力に余裕がなく車両安定性を考えると好ましくない。またさらには、従来の４輪駆動車両の駆動力制御装置は、低μ路面で頻繁に２輪駆動状態と４輪駆動状態とを繰り返す場合も考えられ、その場合、４輪駆動状態時のメカニカルロスや電気的ロスによる車両の加速度や速度の変動により、運転者に違和感を感じさせる虞もあった。

【０００５】本発明は、このような従来の問題点に着目してなされたもので、必要な時のみに４輪駆動状態を継続して走行できる４輪駆動車両の駆動力制御装置を提供することを目的としている。

【０００６】

【課題を解決するための手段】上記問題を解決するために、請求項１に係る４輪駆動車両の駆動力制御装置は、前後輪の一方である主駆動輪と、前後輪の他方である従駆動輪と、主駆動輪の加速スリップ量を検出するスリップ検出手段と、運転者が駆動力の要求をしているか否かを判断する駆動力要求判断手段と、駆動力要求判断手段で運転者が駆動力の要求をしていると判断する場合には、スリップ検出手段で検出した主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出する従駆動力配分最大値更新手段と、駆動力要求判断手段で運転者が駆動力の要求をしていないと判断する場合には、実際の主駆動輪の加速スリップ量に応じた前後輪の駆動力配分比を算出するスリップ対応駆動力配分算出手段と、従駆動力配分最大値更新手段またはスリップ対応駆動力配分算出手段で算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整する駆動力調整手段とを備えたことを特徴とした。

【０００７】また、請求項２に係る４輪駆動車両の駆動力制御装置は、請求項１に記載した４輪駆動車両の駆動力制御装置において、従駆動力配分最大値更新手段は、主駆動輪の加速スリップ量を最大値更新することを特徴とした。

【０００８】また、請求項３に係る４輪駆動車両の駆動力制御装置は、前後輪の一方である主駆動輪と、前後輪の他方である従駆動輪と、主駆動輪の加速スリップ量を検出するスリップ検出手段と、運転者が駆動力の要求をしているか否かを判断する駆動力要求判断手段と、駆動力要求判断手段で運転者が駆動力の要求をしていると判断する場合には、スリップ検出手段で検出した主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出する従駆動力配分最大値更新手段と、駆動力要求判断手段で運転者が駆動力の要求をしていないと判断する場合には、従駆動輪の駆動力配分率を低減またはゼロとなるように前後輪の駆動力配分比を算出する従駆動力配分低減手段と、従駆動力配分最大値更新手段または従駆動力配分低減手段で算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整する駆動力調整手段とを備えたことを特徴とした。

【０００９】また、請求項４に係る４輪駆動車両の駆動力制御装置は、請求項３に記載した４輪駆動車両の駆動力制御装置において、車体速度を検出する車体速検出手段を備え、従駆動力配分低減手段は、車体速度の低下に応じて、従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とした。

【００１０】また、請求項５に係る４輪駆動車両の駆動力制御装置は、請求項３に記載した４輪駆動車両の駆動力制御装置において、車輪速度を検出する車輪速検出手段を備え、従駆動力配分低減手段は、車輪速度の低下に応じて、従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とした。

【００１１】また、請求項６に係る４輪駆動車両の駆動力制御装置は、請求項３に記載した４輪駆動車両の駆動力制御装置において、従駆動力配分低減手段は、時間の経過に応じて、従駆動輪の駆動力配分率が低減される前後輪の駆動力配分比とすることを特徴とした。

【００１２】また、請求項７に係る４輪駆動車両の駆動力制御装置は、請求項１から６までのいずれかに記載した４輪駆動車両の駆動力制御装置において、車輪速度を検出する車輪速検出手段を備え、スリップ検出手段は、前後輪の速度差から加速スリップ量を求めることを特徴とした。

【００１３】また、請求項８に係る４輪駆動車両の駆動力制御装置は、請求項１から６までのいずれかに記載した４輪駆動車両の駆動力制御装置において、主駆動輪に伝達される駆動トルクを算出する主駆動輪トルク算出手段と、主駆動輪の路面反力限界トルクを算出する路面反力限界トルク算出手段とを備え、上記スリップ検出手段

は．主駆動輪に伝達される駆動トルクと主駆動輪の路面反力限界トルクとの差から加速スリップ量を求めることを特徴とした。

【００１４】また、請求項９に係る４輪駆動車両の駆動力制御装置は．請求項１から８のいずれかに記載した４輪駆動車両の駆動力制御装置において．ブレーキ操作をしているか否かを検出するブレーキ操作検出手段を備え．駆動力要求判断手段は．ブレーキ操作していることを検出した場合には運転者が駆動力の要求をしていないと判断し、ブレーキ操作していないことを検出した場合には運転者が駆動力の要求をしていると判断することを特徴とした。

【００１５】また、請求項１０に係る４輪駆動車両の駆動力制御装置は．請求項１から９のいずれかに記載した４輪駆動車両の駆動力制御装置において、アクセル操作をしているか否かを検出するアクセル操作検出手段を備え．駆動力要求判断手段は．アクセル操作していることを検出した場合には運転者が駆動力の要求をしていると判断し、アクセル操作していないことを検出した場合には運転者が駆動力の要求をしていないと判断することを特徴とした。

【００１６】また、請求項１１に係る４輪駆動車両の駆動力制御装置は．請求項１から１０のいずれかに記載した４輪駆動車両の駆動力制御装置において、車体速度を検出する車体速検出手段と．前後輪の荷重配分に応じて前後輪の駆動力配分比を算出する荷重対応駆動力配分算出手段とを備え．所定の車速以下でかつ従駆動力配分最大値更新手段で駆動力配分比の算出処理を行なっている場合には、従駆動力配分最大値更新手段で算出した駆動力配分比と、荷重対応駆動力配分算出手段が算出する駆動力配分比とで．従駆動輪の駆動力が大きい方の駆動力配分比を選択し．選択された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整することを特徴とした。

【００１７】

【発明の効果】請求項１に係る発明によれば、運転者が駆動力の要求をしていると判断する場合には、主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出し、運転者が駆動力の要求をしていないと判断する場合には．実際の主駆動輪の加速スリップ量に応じた前後輪の駆動力配分比を算出し、算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変調整するので．主駆動輪に発生した加速スリップが収束しても、運転者が駆動力の要求をしていると判断する間は４輪駆動状態を維続するため、低μ路面での車両の安定性の確保や悪路での走破性の確保をすることができるという効果が得られる。また、４輪駆動状態を継続することによって．主駆動輪のグリップ力に余裕ができて車両安定性に有利となるし．低μ路面で頻繁に２輪駆動状態と４輪駆動状態とを繰り返すことが避けられことで、車両の加速度や速度の変動による追和感を運転者に感じさせることを防ぐことができる。更に．運転者が駆動力の要求をしていないと判断したら実際の主駆動輪の加速スリップ量に応じた前後輪の駆動力配分比とするため、必要以上に４輪駆動状態を継続することがないという効果が得られる。

【００１８】また、請求項２に係る発明によれば．主駆動輪の加速スリップ量を最大値更新するので、最大値に更新された主駆動輪の加速スリップ量に応じて前後輪の駆動力配分比を算出され．結果的に従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出することと同じとなり．確実に従駆動輪の駆動力配分率を最大値に更新することができるという効果が得られる。

【００１９】また、請求項３に係る発明によれば．運転者が駆動力の要求をしていると判断する場合には．主駆動輪の加速スリップ量に基づき従駆動輪の駆動力配分率を最大値に更新するように前後輪の駆動力配分比を算出し．運転者が駆動力の要求をしていないと判断する場合には．従駆動輪の駆動力配分率を低減またはゼロとなるように前後輪の駆動力配分比を算出し．算出された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変調整するので、主駆動輪に発生した加速スリップが収束しても、運転者の駆動力の要求が無くなったと判断するまでは４輪駆動状態を継続するため、低μ路面での車両の安定性の確保や悪路での走破性の確保をすることができるという効果が得られる。また．４輪駆動状態を継続することによって、主駆動輪のグリップ力に余裕ができて車両安定性に有利となるし、低μ路面で頻繁に２輪駆動状態と４輪駆動状態とを繰り返すことが避けられことで、車両の加速度や速度の変動による追和感を運転者に感じさせることを防ぐことができる。更に．運転者が駆動力の要求をしていないと判断したら従駆動輪の駆動力配分率を低減することで必要以上に従駆動輪の駆動力をかけることを防いだり．または従駆動輪の駆動力配分率をゼロすなわち２輪駆動状態にすることで．必要以上に４輪駆動状態を継続することがないという効果が得られる。

【００２０】また、請求項４に係る発明によれば．運転者が駆動力の要求をしていないと判断する場合．車体速度の低下に応じて、従駆動輪の駆動力配分率を低減するので．徐々に２輪駆動状態にすることで、急激な主駆動輪の駆動力変化による車両安定性の悪化を防ぐことができるという効果が得られる。

【００２１】また、請求項５に係る発明によれば．運転者が駆動力の要求をしていないと判断する場合．車輪速度の低下に応じて、従駆動輪の駆動力配分率を低減するので．徐々に２輪駆動状態にすることで、急激な主駆動輪の駆動力変化による車両安定性の悪化を防ぐことがで

きるという効果が得られる。

【００２２】また、請求項６に係る発明によれば、運転者が駆動力の要求をしていないと判断する場合、時間の経過に応じて、従駆動輪の駆動力配分率を低減するため、徐々に２輪駆動状態になることで、急激な主駆動輪の駆動力変化による車両安定性の悪化を防ぐことができるという効果が得られる。

【００２３】また、請求項７に係る発明によれば、前後輪の速度差から加速スリップ量を求めるので、確実に加速スリップ量が求められるという効果が得られる。

【００２４】また、請求項８に係る発明によれば、主駆動輪に伝達される駆動トルクと主駆動輪の路面反力限界トルクとの差から加速スリップ量を求めるので、前後輪の速度差が微少やゼロであっても、加速スリップ量が求められるという効果が得られる。

【００２５】また、請求項９に係る発明によれば、ブレーキ操作していることを検出した場合には運転者が駆動力の要求をしていないと判断し、ブレーキ操作していないことを検出した場合には運転者が駆動力の要求をしていると判断するので、確実に運転者が駆動力の要求をしているか否かを検出できるという効果が得られる。また、請求項１０に係る発明によれば、アクセル操作していることを検出した場合には運転者が駆動力の要求をしていると判断し、アクセル操作していないことを検出した場合には運転者が駆動力の要求をしていないと判断するので、確実に運転者が駆動力の要求をしているか否かを検出できるという効果が得られる。

【００２６】また、請求項１１に係る発明によれば、所定の車速以下でかつ従駆動力配分最大値更新手段で駆動力配分比の算出処理を行なっている場合には、従駆動力配分最大値更新手段で算出した駆動力配分比と、荷重対応駆動力配分算出手段が算出する駆動力配分比とで、従駆動輪の駆動力が大きい方の駆動力配分比を選択し、選択された前後輪の駆動力配分比になるように前輪と後輪との駆動力を可変に調整するので、発進前の加速スリップが生じていない時でも前後荷重による駆動力配分が選択され最初から４輪駆動状態とすることで、特に加速スリップの発生しやすい発進時には、加速スリップが発生してから４輪駆動状態にするよりも、発進時の加速性や車両の安定性に優れ、かつ必要以上に４輪駆動状態を継続しないという効果が得られる。

【００２７】

【発明の実施の形態】まず、本発明の第一の実施の形態を図面に基づいて説明する。図１は本発明の実施の形態の全体構成を示す図である。また、本実施の形態は、通常は後輪を駆動する２輪駆動を基本に４輪駆動可能な車両について説明する。

【００２８】図中、４輪駆動車両のエンジン１の出力は、トランスミッション２を介して駆動力配分制御アクチュエータ３で前後輪の駆動力配分を行い、フロントプロペラシャフト４とリヤプロペラシャフト５に伝達する。フロントプロペラシャフト４に伝達された駆動力はフロントデフ６と前軸７とを介して右前輪１０ＦＲ，左前輪１０ＦＬに伝達される。同様に、リヤプロペラシャフト５に伝達された駆動力はリヤデフ８と後軸９とを介して右後輪１０ＲＲ，左後輪１０ＲＬに伝達される。

【００２９】車両の各車輪１０ＦＲ、１０ＦＬ、１０ＲＲ、１０ＲＬには車輪速度センサ１２ＦＲ，１２ＦＬ，１２ＲＲ，１２ＲＬが備えられ、それぞれの検出値を駆動力配分制御コントローラ１１へ出力する。また、駆動力配分制御アクチュエータ３は、例えばトランスミッション２とフロントプロペラシャフト４との間に油圧クラッチを介している。なお、油圧クラッチの替りに電磁クラッチであっても構わない。

【００３０】また、運転者の駆動力要求を検出する、すなわちアクセル操作の有無を検出するためのアクセルスイッチ１３と、ブレーキ操作の有無を検出するブレーキスイッチ１４とは、それぞれの検出値を駆動力配分制御コントローラ１１へ出力する。なお、アクセルスイッチ１３の替りにアクセル開度の状態を検出するためのアクセル開度センサを用いても構わないし、ブレーキスイッチ１４の替りにブレーキペダルストローク量を検出するためのブレーキストロークセンサを用いても構わない。

【００３１】また、エンジン１の回転数を検出するエンジン回転数センサ１５を備え、エンジン回転数センサ１５は検出した検出値を駆動力配分制御コントローラ１１へ出力する。また、エンジン１の吸気管路のスロットルバルブには、スロットルバルブの開度を検出するスロットル開度センサ１６を備え、スロットル開度センサ１６は検出した検出値を駆動力配分制御コントローラ１１へ出力する。

【００３２】また、駆動力配分制御コントローラ１１は、各センサの検出値を入力し、主駆動輪の加速スリップ量を算出する。まず、車輪速度センサ１２ＦＲ、１２ＦＬ、１２ＲＲ、１２ＲＬの検出値とエンジン回転数センサ１５の検出値とスロットル開度センサ１６の検出値を入力し、主駆動輪の伝達トルクと主駆動輪の加速トルクとを求め、それらから加速スリップ量である路面反力トルクを算出する。そして、例えば通常は前後輪の駆動力配分比率が前輪０％：後輪１００％の状態から、路面反力トルクに応じて駆動力配分を算出し駆動力配分制御アクチュエータ３へ指令値を出力し、駆動力配分制御アクチュエータ３は油圧クラッチの締結力を制御することで、前後輪の駆動力配分を制御する。

【００３３】次に、図２に基づいて駆動力配分制御コントローラ１１の制御処理について説明する。図２は本発明の第一の実施の形態の制御処理の概要を示すフローチャート図である。この演算処理は、例えば所定時間１０ｍｓｅｃ毎に実行される。

【００３４】まず、ステップＳ１にて駆動力配分制御コ

ントローラ１１は、車輪速度センサ１２ＦＲ，１２ＦＬ，１２ＲＲ，１２ＲＬの各検出値とエンジン回転数センサ１５の検出値とスロットル開度センサ１６の検出値とを入力しステップＳ２へ移行する。ステップＳ２では，入力した車輪速度センサ１２ＲＲ，１２ＲＬの各検出値を基に主駆動輪の車輪加速度を求め、左右輪の平均値を主駆動輪の車輪加速度Ａｆとして算出し、ステップＳ３へ移行する。

【００３５】ステップＳ３では、エンジン回転数センサ１５の検出値とスロットル開度センサ１６の検出値とからエンジン出力トルクＴｅを求め、エンジン出力トルクＴｅとトルクコンバータの増幅比を含めた変速機のギヤ比Ｇと主駆動輪の駆動力配分率Ｋｆとを乗じて主駆動輪の伝達トルクＴｒを算出し，ステップＳ４へ移行する。ステップＳ４では、主駆動輪の駆動系イナーシャ（ギヤ比含む）と主駆動輪の車輪加速度Ａｆとを乗じて主駆動輪の加速トルクＴｉｆすなわち路面反力限界トルクを算出し，ステップＳ５へ移行する。ステップＳ５では、主駆動輪の伝達トルクＴｒから主駆動輪の加速トルクＴｉｆを減じて余剰トルクＴＬを算出し，ステップＳ６へ移行する。ステップ６では，余剰トルクＴＬが大きいほど従駆動輪の駆動力配分率が大きくなるように、余剰トルクＴＬに応じて駆動力配分Ｄを算出し，ステップＳ７へ移行する。

【００３６】ステップＳ７では、ブレーキスイッチ１４の検出値を入力してブレーキ操作がされているか否かを判断する。ブレーキスイッチ１４がＯＦＦすなわちブレーキ操作がされていないと判断した場合には、ステップＳ８へ移行し，ブレーキスイッチ１４がＯＮすなわちブレーキ操作がされていると判断した場合には、ステップＳ１０へ移行する。ステップＳ８では，アクセルスイッチ１３の検出値を入力してアクセル操作しているか否かを判断する。アクセルスイッチ１３がＯＮすなわちアクセル操作していると判断した場合には，ステップＳ９へ移行し、アクセルスイッチ１３がＯＦＦすなわちアクセル操作していないと判断した場合には，ステップＳ１０へ移行する。そして、ステップＳ９にて、前回の計算周期時に算出した駆動力配分より今回の計算周期時に算出した駆動力配分の方が、従駆動輪の駆動力配分率が大きい場合は今回の値（最大値）に更新し，前回の値の方が大きい場合は前回の値（最大値）を今回の計算周期に用いる値とする最大値更新処理を行い，ステップＳ１１へ移行する。また，ステップＳ１０では，今回の計算周期時に算出した駆動力配分の値をそのまま用いるように設定して、ステップＳ１１へ移行する。ステップＳ１１では，ステップＳ９またはステップＳ１０で処理した駆動力配分の値を満足する駆動力配分制御アクチュエータ３の油圧クラッチの締結力を制御する指令値を算出し、駆動力配分制御アクチュエータ３へ出力し、リターンに至る。

【００３７】なお、ステップＳ６の処理では、余剰トルクに応じて駆動力配分Ｄを算出しているが、余剰トルクと車輪の回転半径とから余剰反力を算出し、余剰反力に応じて駆動力配分Ｄを算出する処理としても構わない。

【００３８】更に図３に基づいて説明する。図３は本発明の第一の実施の形態のタイムチャート図である。ここで，図３ａには前輪の車輪速度Ｖｆ，後輪の車輪速度Ｖｒの各経時変化を、同図ｂには後輪の伝達トルクの経時変化を、同図ｃには前輪の駆動力配分率の経時変化を、同図ｄにはタイヤと路面との摩擦係数の経時変化を、同図ｅにはアクセルスイッチ検出値の経時変化を，同図ｆにはブレーキスイッチの検出値の経時変化を示している。

【００３９】まず、Ｔ１の時点から運転者がアクセルを踏み車両が発進し、図３ｂの実線に示すように後輪の伝達トルクが上昇し、破線に示す後輪の路面反力限界トルクを越えると後輪は加速スリップを発生することとなり，図３ａに示すように後輪の車輪速度Ｖｒは前輪の車輪速度Ｖｆに対し大きくなる。また，図３ｅに示すアクセルスイッチはＯＮ、図３ｆに示すブレーキスイッチはＯＦＦのため，駆動力配分は前輪への配分率が最大値に更新されるように処理が行われる。その後、Ｔ２の時点を越えると、図３ｂに示す後輪伝達トルクと路面反力限界トルクとの差が小さくなっていくが，アクセルスイッチＯＮかつブレーキスイッチＯＦＦの間は最大値更新処理によって図３ｃに示すように前輪の駆動力配分率は最大値が維続され続ける。その後、Ｔ３の時点で，後輪の加速スリップが収束して，後輪伝達トルクと路面反力限界トルクとの差がなくなるが，アクセルスイッチＯＮかつブレーキスイッチＯＦＦの状態のため、そのまま最大値更新処理を継続されることで駆動力配分が維続され、図３ｃに示すように前輪の駆動力配分率は最大値が維続され続け、４輪駆動状態を継続することができる。その後，Ｔ４の時点で路面摩擦係数のより低い状態に車両が移行し、後輪の路面反力限界トルクが低下するが４輪駆動状態を維続しているので後輪の伝達トルクは路面反力限界トルクを越えず、後輪が再び加速スリップを発生することはない。

【００４０】その後、Ｔ５の時点で，運転者がアクセル操作を止め、アクセルスイッチはＯＦＦとなることで、駆動力要求がなくなったと判断し、最大値更新処理を止め，実際の後輪伝達トルクと路面反力限界トルクとの差に応じて算出した駆動力配分の値とする処理を行う。しかし，この場合は実際には後輪伝達トルクと路面反力限界トルクとの差が生じていないので前輪の駆動力配分率がゼロとなる駆動力配分となるため，結果的には２輪駆動状態となる。その後、Ｔ６の時点で，運転者がブレーキ操作することで、ブレーキスイッチＯＮとなるが、すでにＴ５の時点でアクセルＯＦＦによって駆動力要求がなくなったと判断しているため、実際の後輪伝達トルク

と路面反力限界トルクとの差に応じて算出した駆動力配分の値とする処理を継続する。なお．駆動力要求がないと判断した場合には、最大値更新処理をしないことで、すなわち実際の後輪伝達トルクと路面反力限界トルクとの差から求める駆動力配分の値とすることで、例えば過剰なアクセルＯＮ操作により後輪の加速スリップが大きく．駆動力要求がないと判断された後にまだ慣性によって後輪伝達トルクと路面反力限界トルクとの差が収束していない場合．実際の後輪伝達トルクと路面反力限界トルクとの差に応じて４輪駆動状態が継続されるため、急激に２輪駆動状態に切り替わることがなく、車両の安定性の確保に役れる。

【００４１】次に、本発明の第二の実施の形態について説明する。全体構成は第一の実施の形態の図１と同様であるが、駆動力配分制御コントローラ１１で実行する主駆動輪の加速スリップ量の算出するための構成と．従駆動輪の駆動力配分率が最大値更新されるように処理するための構成と．運転者の駆動力要求がない場合の処理の構成と、所定の車速以下の場合に駆動力配分を算出するための構成が異なる。

【００４２】主駆動輪の加速スリップ量の算出するための構成は、車輪速度センサ１２ＦＲ．１２ＦＬ．１２ＲＲ．１２ＲＬの検出値を入力し、左右前輪と左右後輪とのそれぞれの平均値を求め．前輪平均値と後輪平均値との差である前後輪回転速度差（前後輪速差）を加速スリップ量として算出するようになっている。また．従駆動輪の駆動力配分率が最大値更新されるように処理するための構成は、加速スリップ量として算出した前後輪速差を最大値更新し．その最大値更新した前後輪速差に応じて駆動力配分を算出するようになっている。また．運転者の駆動力要求がない場合の処理の構成は、運転者の駆動力要求がない場合は、車体速度の低下に応じて従駆動輪の駆動力配分率が低減するように駆動力配分を算出するようになっている。また．所定の車速以下の場合に駆動力配分を算出するための構成は、所定の車速以下の場合は別の駆動力配分算出手段を併行して設け、それで算出する駆動力配分の値と加速スリップ量に基づいて算出する駆動力配分の値とを比較し、従駆動輪の駆動力配分率が大きい方の駆動力配分の値を選択するようになっている。また、駆動力配分制御コントローラ１１は．入力した車輪速度に基づいて車体速度を算出している。

【００４３】次に、図４に基づいて駆動力配分制御コントローラ１１の制御処理について説明する。図４は本発明の第二の実施の形態の制御処理の概要を示すフローチャート図である。この演算処理は、図２の演算処理と同様に同じ所定時間１０ｍｓｅｃ毎に実行される。

【００４４】まず、ステップＳ２１にて駆動力配分制御コントローラ１１は、車輪速度センサ１２ＦＲ．１２ＦＬ．１２ＲＲ．１２ＲＬの各検出値を入力し、車輪速度を基に車体速度Ｖcarnを求め．ステップＳ２２へ移行する。ステップＳ２２では．ステップＳ２１で入力した各車輪速度を基に左右前輪の平均値と左右後輪の平均値とを求めてから．主駆動輪である後輪の平均値から従駆動輪である前輪の平均値を減算して前後輪速差△Ｖｎを算出し、ステップＳ２３へ移行する。ステップＳ２３では．ブレーキスイッチ１４の検出値を入力してブレーキ操作がされているか否かを判断する。ブレーキスイッチ１４がＯＦＦすなわちブレーキ操作がされていないと判断した場合には．ステップＳ２４へ移行し、ブレーキスイッチ１４がＯＮすなわちブレーキ操作がされていると判断した場合には、ステップＳ２６へ移行する。ステップＳ２４では．アクセルスイッチ１３の検出値を入力してアクセル操作しているか否かを判断する。アクセルスイッチ１３がＯＮすなわちアクセル操作していると判断した場合には．ステップＳ２５へ移行し、アクセルスイッチ１３がＯＦＦすなわちアクセル操作していないと判断した場合には．ステップＳ２６へ移行する。そして、ステップＳ２５にて、前回の計算周期時に算出した前後輪速差△Ｖn-1よりも今回の計算周期時に算出した前後輪速差△Ｖｎが大きい場合は今回の値（最大値）に更新し．前回の値の方が大きい場合は前回の値（最大値）を今回の計算周期に用いる値とする処理をする、すなわち駆動力配分を算出するための前後輪速差△Ｖｎの値を最大値に更新処理された値とするように処理をし．フラグを１にセットして、ステップＳ２７へ移行する。また、ステップＳ２６では、前回の計算周期の時に駆動力配分の算出に用いた前後輪速差の値△Ｖｎ-1に、今回の計算周期で求められた車体速度Ｖcarnを前回の計算周期で求められた車体速度Ｖcarn-1で除した値と所定の係数０．７とを乗じた値を駆動力配分の算出に用いる前後輪速差の値△Ｖｎとする処理をする、すなわち駆動力配分を算出するための前後輪速差の値を車体速度に応じて低減する処理をし．フラグを０にセットして、ステップＳ２７へ移行する。ステップＳ２７では．例えば特開平１－９４０２５号公報の第８図のように加速スリップ量が増加するにつれ従駆動輪の駆動力配分率が大きくなるような特性となる演算式やマップから．ステップＳ２５やステップＳ２６で処理された前後輪速差△Ｖｎの値に応じて前後輪の駆動力配分Ｄｌを算出し．ステップＳ２８へ移行する。

【００４５】ステップＳ２８では、車体速度Ｖcarnが所定の車速１５ｋｍ／ｈ以下であるか否かを判断し、所定の車速以下の場合はステップＳ２９へ移行し．所定の車速より大きい場合はステップＳ３０へ移行する。ステップＳ２９では．車体速度の変化率すなわち加減速度を算出し、ステップＳ３１へ移行する。ステップＳ３１では．事前に車両諸元から求まる前後輪の基本荷重配分比を車両の加減速度に応じて補正し、ステップＳ３２へ移行する。すなわちステップＳ３１では．加速時は後輪の荷重配分が増加し、減速時は前輪への荷重配分が増加す

るので、荷重配分の変化量を補正することを行っている。ステップＳ３２では、荷重配分に応じて駆動力配分Ｄ２を算出する。例えば、基本荷重配分比が前輪５０％：後輪５０％の車両が加速により荷重移動し、前輪４０％：後輪６０％になっている場合、駆動力配分を前輪４０％：後輪６０％とし、ステップＳ３３へ移行する。ここで、ステップＳ２７とステップＳ３２とは、それぞれ別々の算出方法により駆動力配分を算出している。ステップＳ３３では、フラグが１であるか否かを判断し、フラグが１であればステップＳ３４へ移行し、フラグが１でなければステップＳ３５へ移行する。ステップＳ３４では、ステップＳ２７で算出した駆動力配分Ｄ１と、ステップＳ３２で算出した駆動力配分Ｄ２とを比較し、従駆動輪の駆動力配分率が大きくなる方の駆動力配分を選択し、ステップＳ３６へ移行する。また、ステップＳ３５では、駆動力配分をステップＳ２７で算出した値Ｄ１とする処理をし、ステップＳ３６へ移行する。ステップＳ３６では、ステップＳ３４またはステップＳ３５で処理した駆動力配分を満足する駆動力配分制御アクチュエータ３の油圧クラッチの締結力を制御する指令値を算出し、駆動力配分制御アクチュエータ３へ出力し、リターンに至る。

【００４６】なお、ステップＳ２６の処理の替りに、前後輪速差の値を強制的にゼロ（$\Delta Vn=0$）とする処理をしても構わない。また、ステップＳ２６の処理の替りに、請求項５に記載の発明のように車輪速度の低下に応じて従駆動輪の駆動力配分率が低減されるように前後輪速差を算出（例えば、$\Delta Vn=\Delta Vn-1\times(Vfn/Vfn-1)\times$所定係数０．７）する処理をしても構わない。また、ステップＳ２６の処理の替りに、請求項６に記載の発明のように前回の計算周期に用いた前後輪速差の値から所定値を減算（例えば、$\Delta Vn=\Delta Vn-$所定値１ｋｍ／ｈ）する処理をしても構わない。

【００４７】更に図５に基づいて説明する。図５は本発明の第二の実施の形態のタイムチャート図である。図示の条件はｂ以外は前記図３と同様である。図５ｂには後輪の車輪速度Ｖｒから前輪の車輪速度Ｖｆを減じた前後輪速差の経時変化を示している。

【００４８】まず、Ｔ１１の時点から運転者がアクセルを踏み車両が発進し車速が１５ｋｍ／ｈに達するまでは、前後輪の基本荷重配分を加速度に応じて補正した荷重配分に応じた駆動力配分にて４輪駆動状態で走行している。その後、Ｔ１２の時点で車速が１５ｋｍ／ｈを越えると、前後輪速差に応じた駆動力配分とする処理をするようになるが、図５ａおよびｂに示すように実際には前後輪速差が生じていないので、２輪駆動状態となる。その後、Ｔ１３の時点で、路面摩擦係数のより低い状態に車両が移行し、後輪の路面反力限界が低下して後輪の駆動力が後輪の路面反力限界を越えると後輪は加速スリップを発生する。この時、図５ａに示すように後輪の車輪速度Ｖｒは前輪の車輪速度Ｖｆに対し大きくなるため、前輪の車輪速度Ｖｆと後輪の車輪速度Ｖｒとの間に前後輪速差が生じる。また、図５ｅに示すアクセルスイッチはＯＮ、かつ図５ｆに示すブレーキスイッチはＯＦＦのため、図５ｂに示すように前後輪速差を最大値に更新する処理が行われ、図５ｃに示すように最大値更新された前後輪速差の値に応じて、前後輪の駆動力配分が制御されることで前輪の駆動力配分率も最大値に更新され続ける。その後、後輪の駆動力の低減により図５ａに示す実際の前後輪速差は減少してゆき、Ｔ１４の時点で、後輪の加速スリップが収束して、実際の前後輪速差がなくなるが、アクセルスイッチＯＮかつブレーキスイッチＯＦＦの状態のため、最大値更新処理によって駆動力の演算に用いられる前後輪速差の値は図５ｂに示すように最大値が維持され続ける。その結果、前輪の駆動力配分率は最大値に更新された状態で維持するため、図５ｃに示すように前輪の駆動力配分率はゼロとならず４輪駆動状態を維持することができる。

【００４９】その後、Ｔ１５の時点で、運転者がアクセル操作を止め、アクセルスイッチはＯＦＦとなることで、駆動力要求がなくなったと判断し、前後輪速差の最大値更新処理の替りに前回の演算処理の前後輪速差の値を基に車速に応じてその値を低減する処理を行うため、車速の低下とともに演算処理に用いられる前後輪速差の値は小さくなり、徐々に２輪駆動状態に近づく。その後、Ｔ１６の時点で、運転者がブレーキ操作することで、ブレーキスイッチＯＮとなるが、すでにＴ１５の時点でアクセルＯＦＦによって駆動力要求がなくなったと判断しているため、前回の演算処理の前後輪速差の値を基に車速に応じてその値を低減する処理を継続する。

【００５０】その後、車速が再び１５ｋｍ／ｈ以下となるが、アクセルスイッチとブレーキスイッチの状態から駆動力要求がないと判断するため、最大値更新して算出する処理が行われないので、最大値更新されて算出する駆動力配分と荷重配分に応じて算出する駆動力配分比とで従駆動輪の駆動力が大きい方の駆動力配分を選択する処理も行われず、前後輪速差に応じた駆動力配分の算出値のみによる処理が継続され、車速に応じて徐々に２輪駆動状態となってゆく。

【００５１】以上説明したように、本発明を実施することで、駆動力配分制御手段を備える４輪駆動車両において、頻繁に加速スリップが起きやすい低μ路面や悪路において、車両の安定性の確保や悪路での走破性の確保をすることができ、かつ必要な時だけ４輪駆動状態を継続することができる。また、４輪駆動状態を継続することによって、主駆動輪のグリップ力に余裕ができて車両安定性に有利となるし、低μ路面で頻繁に２輪駆動状態と４輪駆動状態とを繰り返すことが避けられることで、車両の加速度や速度の変動による追和感を運転者に感じさせることを防ぐことができる。

【００５２】また、図２の演算処理のステップＳ１～ステップＳ５および図４の演算処理のステップＳ２１～ステップＳ２２が、本発明の加速スリップ検出手段を構成している。また、図２の演算処理のステップＳ７～ステップＳ８および図４の演算処理のステップＳ２３～ステップＳ２４が、本発明の駆動力要求判断手段を構成している。また、図２の演算処理のステップＳ９および図４の演算処理のステップＳ２５が、本発明の従駆動力配分最大値更新手段を構成している。また、図２の演算処理のステップＳ１０が、本発明のスリップ対応駆動力配分算出手段を構成している。また、図２の演算処理のステップＳ３が本発明の主駆動輪トルク算出手段を、ステップＳ４が本発明の路面反力限界トルク算出手段を構成している。また、図４の演算処理のステップＳ２６が、本発明の従駆動力配分低減手段を構成している。また、図４の演算処理のステップＳ２９～ステップＳ３２が、本発明の荷重対応駆動力配分算出手段を構成している。また、図１の駆動力配分制御アクチュエータ３が、本発明の駆動力調整手段を構成している。

【００５３】なお、上記実施の形態では、前後輪の駆動力配分比を算出するようにしているが、駆動力配分比の算出の替りに従駆動輪へ伝達する駆動トルクまたは従駆動輪から路面へ伝達する駆動力を算出するようにしても同じことである。

【００５４】なお、上記実施の形態では、荷重対応駆動力配分算出手段は前後荷重配分比を駆動力配分比とした場合について説明したが、それ以外にも前後の荷重配分に応じて一定の駆動力配分（例えば、前輪５０％：後輪５０％）とするように処理しても構わない。

【００５５】なお、上記実施の形態では、駆動力要求判断手段として、アクセル操作とブレーキ操作とを組合せた場合について説明したが、アクセル操作・ブレーキ操作のどちらか１つでも構わない。が、アクセルとブレーキとを同時操作する場合も考えられるので、それらを組合せた方がより適切に運転者の駆動力の要求があるか否かを検出できるので好ましい。

【００５６】なお、上記実施の形態では、通常は後輪を駆動する２輪駆動を基本に４輪駆動可能な車両について説明したが、駆動力配分を制御できる４輪駆動可能な車両であれば他の形態であっても適用可能である。また、上記実施の形態のような内燃機関の出力を前後に配分する４輪駆動可能な車両以外でも、例えば前後輪の一方を内燃機関で駆動し前後輪の他方を電動機で駆動する４輪駆動可能な車両や、前輪と後輪とが別々の内燃機関または電動機で駆動される４輪駆動可能な車両にも適用可能である。

【００５７】なお、上記実施の形態では説明していないが、本発明を基に公知技術（例えばタイトブレーキング現象を防止するための公知技術）などを組合せて、駆動力配分をさらに補正するようにしても構わない。

【図面の簡単な説明】

【図１】本発明の実施の形態の全体構成を示す図である。

【図２】本発明の第一の実施の形態の制御フローチャート図である。

【図３】本発明の第一の実施の形態のタイムチャート図である。

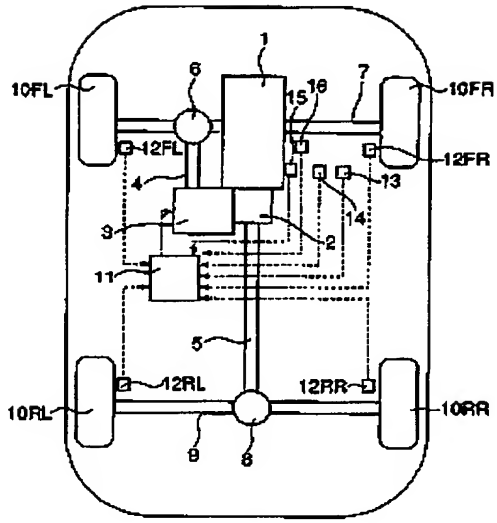
【図４】本発明の第二の実施の形態の制御フローチャート図である。

【図５】本発明の第二の実施の形態のタイムチャート図である。

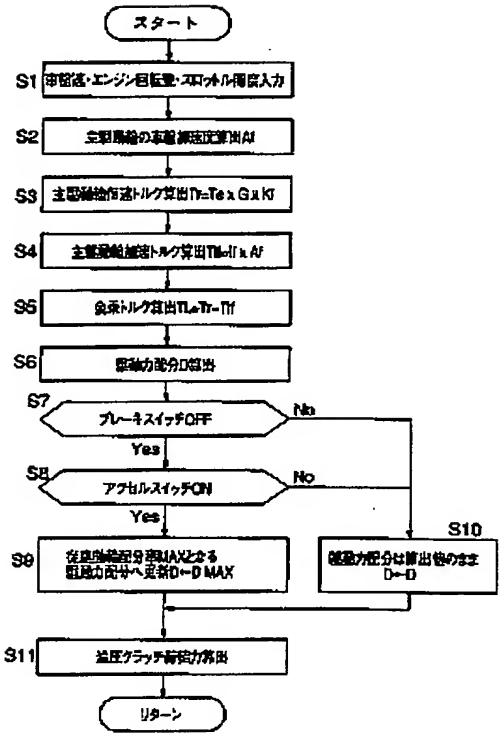
【符号の説明】

１：エンジン
３：駆動力配分制御アクチュエータ
１１：駆動力配分制御コントローラ
１２ＦＲ，１２ＦＬ，１２ＲＲ，１２ＲＬ：車輪速度センサ
１３：アクセルスイッチ
１４：ブレーキスイッチ

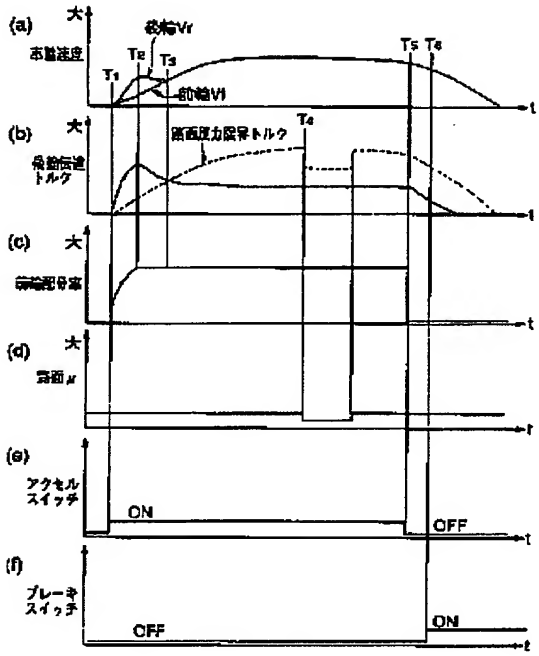
【図１】


1
6
7
10FL
10FR
15
16
12FL
12FR
4
13
14
3
2
11
5
12RL
12RR
10RL
10RR
9
8

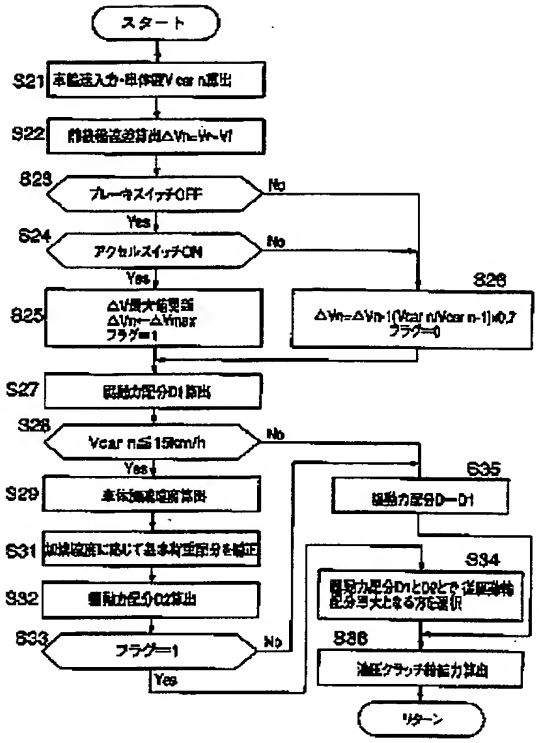
【図２】


スタート
S1
S2
S3
S4
S5
S6
S7
ブレーキスイッチOFF
No
Yes
S8
アクセルスイッチON
No
Yes
S9
S10
S11
リターン

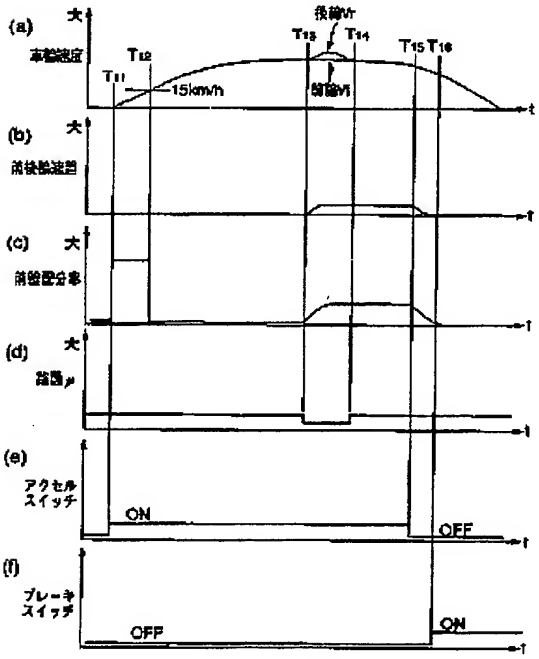
【図３】


(a)
大
後輪Vr
T1
T2
T3
T5
T6
前輪Vf
t
(b)
大
後輪伝達トルク
T4
t
(c)
大
t
(d)
大
t
(e)
アクセルスイッチ
ON
OFF
t
(f)
ブレーキスイッチ
OFF
ON
t

【図４】


スタート
S21
S22
S23
No
Yes
S24
No
Yes
S25
S26
S27
S28
No
Yes
S29
S31
S32
S33
No
Yes
S34
S35
S36
リターン

【図５】


(a)
大
後輪Vr
T11
T12
T13
T14
T15
T16
15km/h
前輪Vf
t
(b)
大
t
(c)
大
t
(d)
大
t
(e)
アクセルスイッチ
ON
OFF
t
(f)
ブレーキスイッチ
OFF
ON
t